Physics 2204
Unit 2: Dynamics
Worksheet 8: Problem Solving With Newton's Laws

Student Name:_____

Problem-Solving Strategy: Applying Newton's Laws of Motion

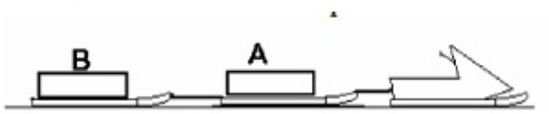
- Identify the physical principles involved by listing the givens and the quantities to be calculated.
- Sketch the situation, using arrows to represent all forces.
- Determine the system of interest. The result is a free-body diagram that is essential to solving the problem.
- Apply Newton's second law to solve the problem. If necessary, apply appropriate kinematic equations from the chapter on motion along a straight line.
- Check the solution to see whether it is reasonable.

Example 1:

Two dynamics carts are resting side by side , as shown, on a level frictionaless surface. A force of 4.6 N is applied to the larger of the two. Use this information to find the force B exerts on cart A.

Example 2:

A 250.0 kg Skidoo is hauling a tandem load of firewood as shown in the diagram. Sled A and its firewood has a mass of 350.0 kg while sled B and its firewood has a mass of 180.0 kg. The skidoo pulls with a force of 2.90×10^3 N [R]. Ignore any friction.



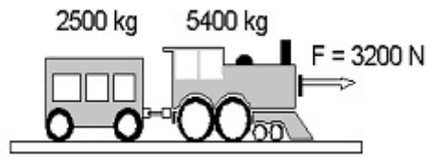
(A) What will be the acceleration of sled A?

(B) With what force does sled B pull back on sled A?

(C) Consider sled B in isolation. How would the answer to part B change if sled B experiences a frictional force of 5.0×10^2 N [L].

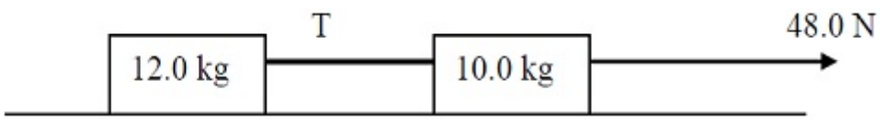
Example 3:

A train consists of a locomotive with a mass of 5400 kg and a passenger car with a mass of 2500 kg. A force of 3200 N is accelerating the entire train. Find the force exerted on the passenger car by the locomotive. (assume there is no friction



Example 4:

Two boxes on a frictionless table are connected by a rope. A force of 48.0 N is applied as shown

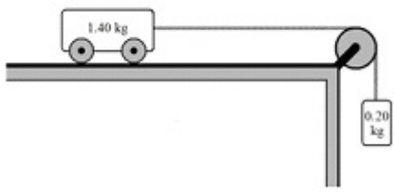


A) Calculate the magnitude of the acceleration of the blocks.

B) Calculate the magnitude of the tension, T, in the connecting rope

Example 5:

A dynamics cart is connected to a 0.20 kg hanging mass by a massless string over a frictionless pulley. The force of friction between the cart and the table is 0.36 N.

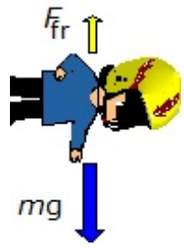


A) Calculate the magnitude of the acceleration of the system when the 0.20 kg mass is released

B) Calculate the tension in the string when the 0.20 kg mass is released.

Example 6:

The total mass of a skydiver and her gear is 65 kg. What air friction is she experiencing when her free fall acceleration is reduced from 9.8 to 7.2 m/s^2

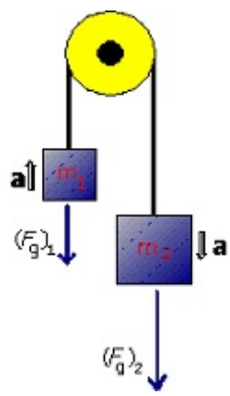


Example 7:

A 25 kg block (m_1)and a 35 kg block (m_2) are connected by a rope over a frictionless pulley as shown.

A) Calculate the magnitude of the acceleration of the system of blocks?

B) Calculate the magnitude of the tension in the connecting rope.



Example 8:

A model rocket with a mass of 0.600 kg accelerates from rest to 140.0 m/s in 4.5 s. Calculate the average force that the rocket applies to the exhaust gasses that are pushed out the nozzle at the rear of the rocket.

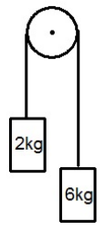
Example 9:

A pickup truck has a mass of 2100 kg. Its engine applies an accelerating force of 3800 N. If the truck is attached to a 750 kg trailer, how much force will the trailer apply to the pickup? (assume there is no friction).

PART A: MULTIPLE CHOICE

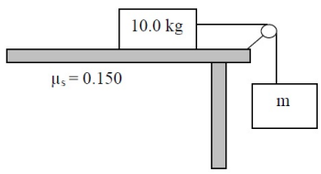
Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided.

1. Two masses are connected by a string over a frictionless pulley as shown. What is the acceleration of the system of masses?



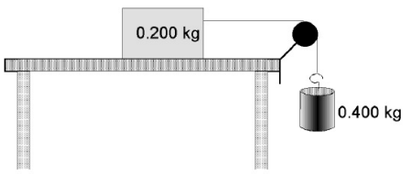
(A) 4.9 m/s^2
(B) 6.5 m/s^2
(C) 7.4 m/s^2
(D) 9.8 m/s^2

2. A hanging mass, m, is attached to a stationary mass of 10.0 kg on a horizontal table. If the coefficient of static friction between the table and the stationary mass is 0.150, what is the maximum hanging mass that will keep the system at rest?



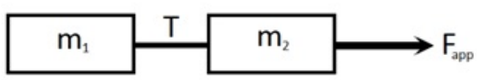
(A) 1.02 kg
(B) 1.50 kg
(C) 10.0 kg
(D) 66.7 kg

3. A 0.400 kg mass is attached to a 0.200 kg block as shown. Assuming no friction, what is the magnitude of the acceleration of the 0.200 kg mass?



(A) 3.33 m/s^2
(B) 6.53 m/s^2
(C) 9.80 m/s^2
(D) 19.6 m/s^2

4. A force of 22 N is pulling two carts to the right on a frictionless surface. If both carts have the same mass, what is the tension, T, in the string connecting m_1 and m_2?



(A) 0 N
(B) 11 N
(C) 22 N
(D) 44 N

5. A traffic light is hanging motionless on a single, vertical chain. Which statement is correct regarding tension in the chain (T) and the force of gravity on the light (F_g)?

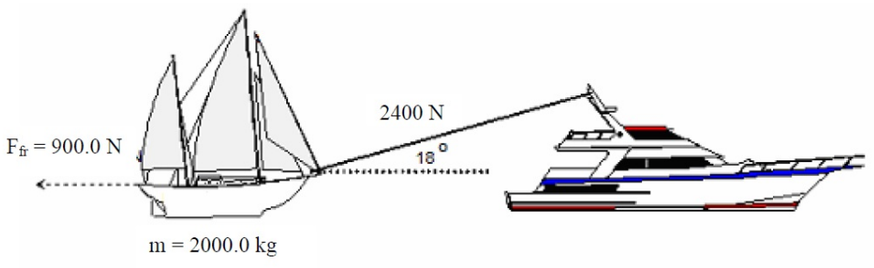
(A) $T = 0$
(B) $T < F_g$
(C) $T = F_g$
(D) $T > F_g$

6. An object of mass M is hung by a string from the ceiling of an elevator that is accelerating upwards at 0.98 m/s^2. What is the tension in the string?

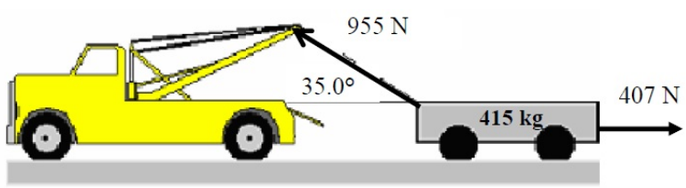
(A) Mg
(B) 1.1 Mg
(C) 0.9 Mg
(D) 2 Mg

PART B: WRITTEN RESPONSE

1. A disabled sailing vessel is under tow as shown. The towline is making an angle of 18° with the horizontal and is supplying a force of 2400 N. If its mass is 2000.0 kg and it is experiencing a horizontal frictional force of 900.0 N, calculate the magnitude of the acceleration of the sailing vessel.



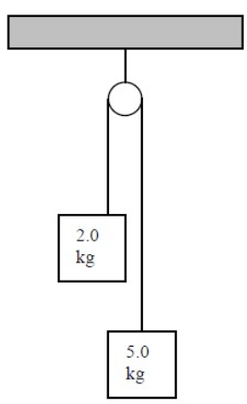
2. A tow truck is applying a 955 N force at 35.0° above the horizontal to a 415 kg cart as shown. The frictional force between the cart and the road is 407 N.



i) Draw a free body diagram for the cart.

ii) Calculate the magnitude of the acceleration of the cart.

3. A 2.0 kg block and a 5.0 kg block are connected by a rope over a frictionless pulley as shown.



(i) Calculate the magnitude of the acceleration of the system of blocks.

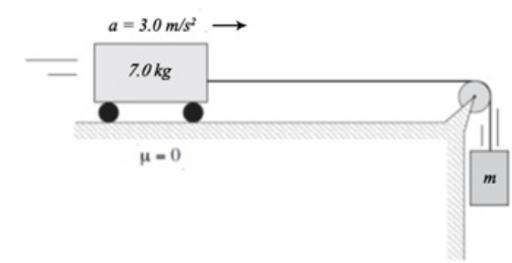
(ii) Calculate the magnitude of the tension in the connecting rope.

4. A bag containing 20.0 kg of groceries is lifted vertically upwards from the floor to a table. The maximum force the bag can withstand without ripping is 250 N.

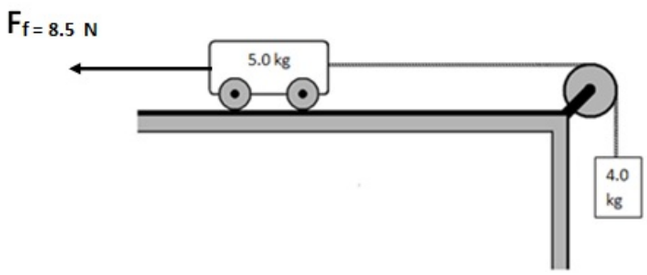
i) Calculate whether the bag will rip if it is lifted at a constant speed.

ii) Calculate whether the bag will rip if it is lifted with an acceleration of 5.10 m/s^2.

5. A 7.0 kg cart is being accelerated at 3.0 m/s^2 by a hanging mass in a frictionless system. Calculate the value of the hanging mass.



6. Two masses are connected by a massless string over a frictionless pulley. There is a frictional force of 8.5 N acting on the 5.0 kg cart.



i) Calculate the acceleration of the system when the 4.0kg mass is released.

ii) Calculate the tension in the string when the 4.0kg mass is released.